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AUTHOR Buckland, Michael; Dye, Charles M.
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ABSTRACT

This paper presents a history of electronic distance education in the United States. Three broad categories of delivery systems are described: (1) over-the-air open circuit systems such as VHF-UHF stations, microwave, instructional television fixed service (ITFS), communications satellites, and educational radio and television; (2) through-the-wire, or closed circuit systems such as intraschool closed-circuit television, cable television, telephone applications, and campus information networks; and (3) direct physical delivery, including hand-carried videotapes, cassettes, discs, mail, videotape recordings, and library materials. Discussion focuses primarily on over-the-air and through-the-wire delivery systems, with emphasis on relevant U.S. government legislation. The history begins in 1844 with the telegraph, continues through the telegraph printer, the first transatlantic telegraph cable (1869), telephones (1876), the phonograph (1877), and through 1896 with the first patent for radio obtained by Marconi. Twentieth century advancements in communications technology are discussed in detail. Federal legislation noted includes the 1912 and 1927 Radio Acts, the development of the Federal Radio Commission, predecessor of the Federal Communications Commission (FCC), and other standards adopted first for the regulation of the radio spectrum and then for the regulation of the television spectrum. Also included in this discussion are the development of national organizations and agencies, convened in response to special interest groups and to specific uses for the media. Two chronologies are provided: the development and use of technology from 1812 to 1990, and legislation and philanthropy in distance education from 1910 to 1984. (25 references) (DB)

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THE DEVELOPMENT OF ELECTRONIC DISTANCE EDUCATION DELIVERY SYSTEMS IN THE UNITED STATES

RECURRING AND EMERGING THEMES IN HISTORY AND PHILOSOPHY OF EDUCATION

DIVISION F PAPER SESSION

PRESENTED BY

MICHAEL BUCKLAND

AND

DR. CHARLES M. DYE

AT THE

MID-WESTERN EDUCATIONAL RESEARCH ASSOCIATION

THIRTEENTH ANNUAL MEETING

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)"

THE DEVELOPMENT AND USE OF TECHNOLOGY IN ELECTRONIC DISTANCE EDUCATION IN THE UNITED STATES

1812	Babbage's calculating machine
1844	Telegraph
1869	**FIRST** transatlantic telegraph cable
1874	**FIRST** experiments with TV
1876	Telephone
1877	Phonograph
1889	Magnetic recording
1890	Hollerith's census machine used in 1890 census
1895	"Wireless" radio
1896	Marconi's first patent
1896	Tulane, Wittenburg repeat Marconi experiments - Ohio State, Arkansas, Minnesota, Wisconsin and others establish radio laboratories
1901	**FIRST** transatlantic telephone message
1906	Cornell offers credit courses in communications engineering and radio code
1917	**FIRST** electronic distance education broadcast (station 9XM, later WHA, at University of Wisconsin) - [Wisconsin Idea]
1920	KDKA (Pittsburgh) broadcasts Harding-Cox election returns
1923	Iconoscope (television) patented by Vladimir Zworykin
1923	Picture of President Harding transmitted from Washington to Philadelphia
1925	Association of Colleges and Universities Broadcasting Stations is formed
1927	Bell Telephone broadcasts image of President Hoover
1928	RCA Educational Hour begins on NBC
1929-37	Ohio School of the Air
1930's	Major development of FM radio and TV
1930-40	American School of the Air on CBS
1932-34	Iowa State, Purdue, Kansas State produce teaching programs using scanning disc
1933	**FIRST** broadcast via educational television (ETV) - Iowa State

1935	Joint Radio Project begins
1938	NBC arranges demonstration of TV in college classrooms
1939	NBC begins regular TV programming
1940	RCA begins large-scale advertising of television receivers
1942	RCA uses TV to train air wardens
1944	**FIRST** major digital computer put into use
1945	CBS standards for color TV accepted by FCC
1947	Philadelphia public schools broadcast classroom instructional programs over three local commercial stations
1949	Cable TV established in remote areas of Pennsylvania and Oregon
1950	The term "telecourse" comes into general use
1950	University of Michigan Hour telecourse, WWJ-TV, Detroit
1951	Introductory Psychology, WEWS-TV, Cleveland
1952-53	90 commercial TV stations carry 256 educational programs
1953	Cable TV capable of same 12 channel capability as VHF
1957	**FIRST** TV coursework for credit - Sunrise Semester, New York University, CBS
1958	**FIRST** U.S. communication satellite is launched
1962	**FIRST** satellite transmission of TV - California to Massachusetts
1962	**FIRST** reliable transatlantic TV transmission - Telstar I - launched and paid for by AT&T
1963	VCR becomes available
1976	CPB constructs its own satellite interconnection
1981	IBM introduces its first Personal Computer (PC)
1984	Divestiture of Bell Operating System
1984	National Technological University founded - provides advanced degree opportunities for engineers via satellite
1988-89	About 7% of school districts have satellite dishes
1988-89	Codec (central element in a video teleconferencing system) shipments triple
1990's	C-band and Ku-band replacing by Ka-band satellites
1990's	Public Service Telephone Networks - general purpose broadband network

prepared by Michael Buckland

LEGISLATION AND PHILANTHROPY
IN ELECTRONIC DISTANCE EDUCATION
IN THE UNITED STATES

1910	Wireless Ship Act
1912	First code broadcasting license to Philadelphia School of Wireless Telegraphy
1912	Radio Act
1912	First experimental license to St. Joseph's College in Philadelphia
1920's	Period of increasing involvement by private philanthropic foundations
1921	First educational institution officially licensed to operate a radio station - Later Day Saints University, Salt Lake City
1926	All restraints removed from broadcasting
1927	Radio Act of 1927 authorizes FRC (Federal Radio Commission) to regulate broadcasting
1928	Davis amendment - equalizes geographical assignments of channels, time and power
1930	Rockefeller Foundation and the Carnegie Corporation finances the National Advisory for Radio in Education
1934	FCC established
1936	Ford Foundation created - becomes the largest private benefactor of educational radio and TV
1938	FCC creates a class of stations called "noncommercial educational" - Cleveland Board of Education receives first license
1940	FM broadcasting formally established on a limited basis
1941	First educational FM station in Cleveland
1945	FCC allocates 20 FM channels for noncommercial educational stations - 88.1 to 91.9
1946	Educational broadcasters permitted to purchase surplus war-time broadcasting equipment
1948	Awakening of educational broadcasters to the potential of TV
1948	FCC "freeze order"

1949-50 Allerton House seminars

1951 FCC reserves some UHF for noncommercial educational stations

late 1950's - Midwest Program on Airborne Television Instruction - funded by the Ford Foundation

1958 National Defense Education Act (includes Title VII - Educational Media Research)

1962 All-Channel Television Receiver Act - requires all new TV sets to provide full channel capability including UHF

1962 Educational Television Facilities Act - first direct federal support of public broadcasting

1962 Communication Satellite Act - establishes hybrid public-private commercial corporation

1963 FCC establishes Instructional Television Fixed Service

1966 FCC asserts jurisdiction over all cable TV systems

1967 Carnegie Report - popularizes the term "public broadcasting"

1967 Public Broadcasting Act - establishes Corporation for Public Broadcasting (CPB)

1969 Ford Foundation yields leadership to CPB

1969 Public Broadcasting Service (PBS) begins (distributor)

1971 National Public Radio (NPR) network begins (publisher and distributor)

1977 Formation of the Carnegie Commission on the future of Public Broadcasting

1978 Public Telecommunications Financing Act - broadens responsibility of CPB

1984 Cable Act - restricts delivery of video over local and regional telephone lines

prepared by Michael Buckland

INTRODUCTION

It is the last decade of the century and there is a revolution beginning in electronic distance education. What year is it? It is 1890 and it is 1990. The first revolution was radio. Today's revolution is interactive multimedia and possibly virtual reality.

The first wave of electronic distance education was sound (radio). The second wave was sound and sight (television). The third wave was sound, sight and touch (computers). A key feature of the third wave was interactiveness. Even with this interaction, there was a division or wall between the machine and the person. The fourth wave, yet to come, may dissolve this wall as the machine gains the capability to read, to talk, to recognize objects such as people on sight, and to "think."

During the 1800's not only did we have an industrial revolution, but also a revolution of telecommunication technology which, one century later, would envelope our daily lives and provide a basis for an on-going evolution in distance education. It began with the telegraph (1844), followed by work on alternating current, electromagnetic disturbances, the first telegraph printer (during the Civil War), the first transatlantic telegraph cable (1869), the telephone (1876), the phonograph (1877), magnetic recording (1889), the amplifying "audion" radio tube (allowing long distance calls) and finally the "wireless" radio (1895). The first transatlantic message occurred in December, 1901.[1]

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[1]Victor Gorelick, ed., Archie and the History of Electronics (Mamaroneck, NY: Archie Comic Publications), 18-22.

Another event occurring during the 1800's was the development of computers. Beginning with the Babbage calculating machine in 1812,[2] development continued into the late 1800's with the Hollerith census machine[3] which was used in the 1890 census. Hollerith also started the Tabulating Machine Company which eventually became IBM.[4]

Before we go any farther, let me attempt to provide a working definition for electronic distance education. According to Garrison[5], distance education technologies is two-way communications which include (1) correspondence (first generation) delivered by mail, (2) teleconferencing (second generation) delivered by telecommunications, and (3) microprocessor based (third generation) delivered by microprocessor.

Garrison also states the this kind of communication is "when contact between teachers and students is non-contiguous."[6] Distance learning is the concept of providing instruction for students who are not in the classroom with the instructor.[7] In

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[2]Charles K. Kinzer, Robert D. Sherwood, John D. Bransford, eds., Computer Strategies for Education, (Columbus, OH: Merrill Publishing Company, 1986), 16.

[3]Ibid., 18.

[4]Ibid., 19.

[5]D. R. Garrison, Understanding Distance Education: A Framework for the Future (London and New York: Routledge, 1989), 50.

[6]Ibid., Foreword.

[7]Nelson A. Foell, "Electronic Distance Learning and Teacher Education: It Can Work," Journal of Industrial Teacher 27, no. 3 (1990): 75.

distance education the person, persons or institutions providing instruction are separated either in place or time, or both, from their learners.[8] Distance learning usually occurs in real time but not always. The modern definition of distance education may be "the use of telecommunications to offer instruction to students in different geographical locations at the same or different times."[9]

Basically, there are three broad overall categories of distribution of electronic distance education. The first is over-the-air open circuit systems such as VHF-UHF stations, microwave, instructional TV fixed service (ITFS), satellites, radio, television an others. The second category is through-the-wire or closed circuit systems as intraschool closed-circuit TV, cable TV, most telephone applications, and campus networks. The third category is direct physical delivery including hand-carried videotapes, cassettes, discs, mail delivery, audio-visual (e.g. VCR), library materials, and so forth.[10]

I will be primarily discussing over-the-air delivery systems. Through-the-wire delivery systems will also be mentioned. This paper will be limited to the historical development of electronic delivery systems in distance education in the United States including pertinent legislation.

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[8]Michael G. Moore, "University Distance Education of Adults," TechTrends (September 87): 13.

[9]Nancy Roberts and others, Integrating Telecommunications into Education (Englewood Cliffs, NJ: Prentice Hall, 1990), 222.

[10]Donald N. Wood and Donald G. Wylie, Educational Telecommunications (Belmont, CA: Wadsworth Publishing Company, 1977), 183.

BEGINNINGS

In 1896, Marconi obtained the first patent for a radio device. Also in 1896, Tulane University and Wittenburg College repeated the earlier Marconi experiments. Ohio State, Arkansas, Nebraska, Minnesota, Wisconsin, and other universities established radio laboratories.[11] In 1906, Cornell offered credit courses in communications engineering and radio code.[12]

Until June 24, 1910, there were no rules or regulations for radio code broadcasting. On this date, the Wireless Ship Act, the first law dealing with radio was passed. In 1912, the Senate began hearings on a bill concerning interstate radio communications.[13] As a result, the Radio Act passed by Congress on August 13, 1912 was the first act regarding interstate communication by radio including issuance and registration of licenses.[14]

The Secretary of Commerce and Labor issued the first experimental license to St. Joseph's College in Philadelphia in 1912 and issued the first code broadcasting license to the Philadelphia School of Wireless Telegraphy in the same year.[15] Three years before KDKA in Pittsburgh and WWJ in Detroit were to start conflicting claims as the first radio station on the

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[11]George Horner Gibson, "The Development of Federal Policy Toward Noncommercial Educational Broadcasting" (Ph.D. diss., University of North Carolina, 1961), 3.

[12]Ibid., 4.

[13]Ibid., 4.

[14]Ibid., 5.

[15]Gibson, 6.

air[16], experimental radio station 9XM (later called WHA) at the University of Wisconsin originated the first electronic distance education broadcast, a musical program, in 1917.[17] This involvement of the University of Wisconsin with the extended community was congruent with the "Wisconsin Idea."

Several important technical improvements were made in radio communications during World War I. One of the stations to begin broadcasting after the war was KDKA in Pittsburgh on October 27, 1920. On November 2, 1920, KDKA broadcast the Harding-Cox election returns. Radio had entered the home as an educational and informational device.[18] The first educational institution officially licensed to operate a radio station was the Latter Day Saints University, Salt Lake City, Utah, in 1921.[19] Followed by the Universities of Wisconsin and Minnesota on January 13, 1922, seventy-one other educational institutions received regular broadcast licenses by the end of 1922.[20] This was the beginning of educational broadcasting, a phenomenon that would employ thousands of persons and cost close to a billion dollars during the next half-century.[21]

Early college broadcasting was very creative. It soon went beyond just transmitting educational matter. It offered sporting events, dramas, concerts, and lectures for college credit. Yet only a small minority of teachers were willing to experiment with a new technology which they perceived as a threat to their employment.[22]

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[16]Wood, 17.
[17]Gibson, 6.
[18]Ibid., 7.
[19]Wood, 17.
[20]Gibson, 7.
[21]Wood, 17.

THE TURMOIL OF THE 1920'S

The United States had no law regulating land-based public broadcasting stations until 1927. The Radio Act of 1912, the governing law until 1927, was designed to control point-to-point communications between ships, ship to shore, and stations on land involved with ships.[23]

By the mid-1920's, only half of the educational institutions that held broadcast licenses actually had stations on the air.[24] From 1920 to 1930, educational institutions constructed at least 176 radio stations, of which only 35 survived the 1929 crash. The survivors were mostly at land grant colleges, where commitment to off-campus learning and education was mandated under the Morrill Act.[25] During the late 1920's and into the harsh financial climate of the 1930's, many educational radio operations were kept functioning as "schools of the air" on commercial stations. One of the first of these was the Ohio School of the Air which started on January 7, 1929 and lasted until 1937, ceasing operation after several cutbacks in state funds. The RCA Educational Hour was begun on NBC on October 26, 1928 and CBS broadcast the American School of the Air from 1930 to 1940.[26]

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[22]Gibson, 9.

[23]Robert J. Blakely, Educational Broadcasting in the United States (Syracuse, N.Y.; Syracuse University Press, 1979), 34.

[24]Wood, 18.

[25]Curtis, 10.

[26]Wood, 21.

There was a rapid proliferation of radio licenses in 1922. Secretary of Commerce Herbert Hoover, sensing the potential problems of unregulated broadcasting, took the initiative and called for a public conference to study the problems of unrestricted broadcasting, to make recommendations for the extension of the regulatory powers of the government and draft technical provisions for model legislation to be submitted to Congress.[27]

As the early educational movement was struggling to find its organizational structure, Secretary of Commerce Herbert Hoover assembled early broadcasters, commercial and university, for a series of national radio conferences. The first conference met in Washington, D.C. on February 27,1922. At the fourth conference also held in Washington, D.C. in 1925, college and university broadcasters, recognizing their unique problems and needs, formed their own organization, the Association of College and University Broadcasting Stations (ACUBS).[28] [29]

On April 16, 1926, a Federal court decision stated that the Department of Commerce action to restrict channels and hours of operation might be unconstitutional.[30] On July 9, 1926, all restraints were removed and broadcasting began a period of

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[27]Gibson, 8.

[28]The use of letter abbreviations for organization names was very common throughout the history of educational telecommunications. See Appendix A for a selected list of educational telecommunications related organizations.

[29]Wood, 23.

[30]Gibson, 15.

unlimited air time, transmitting power, channel shifts, and interference.[31]

The public responded quickly. Individuals and organizations, particularly businesses, nationwide demanded legislative remedy. Congress approved legislation on February 23, 1927, effective immediately, know as the Radio Act of 1927.[32] The Radio Act of 1927 authorized the Federal Radio Commission (FRC) to regulate the traffic on the air waves.[33] The FRC was the predecessor of the FCC. The FRC was established in an effort to bring order into a situation that had become broadcasting chaos. The FRC had to impose severe limitations, including air time and frequency assignments, on the broadcasting stations. In many decisions, the FRC seemed to discriminate against educational broadcasters.[34]

In 1928, Congress debated extending the FRC for another year. Representative Ewin L. Davis felt that the FRC had misunderstood the public interest clause. Congress passed a bill which included the Davis Amendment that directed the FRC to equalize geographical assignments of channels, time, and power. By reducing the number of large, powerful metropolitan stations, more local nonprofit and educational stations would become available. Despite this amendment, the FRC was slow in responding to geographical dispersement.[35]

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[31]Ibid., 16.
[32]Blakely, 46.
[33]Ibid., 49.
[34]Wood, 29.
[35]Gibson, 23-24.

According to Gibson[36], "a smoldering mutual distrust between educators who cooperated with commercial stations and educators who associated with college stations was soon to break out in the open." On May 24, 1929, Secretary of the Interior Ray Lyman Wilbur called a conference to discuss the potential of radio broadcasting and the role of the Federal government in developing this potential. Before adjournment, the conference voted unanimously to ask Secretary Wilbur to appoint a factfinding committee to investigate the further possibilities of radio education.[37]

During the late 1920's, there was an increasing involvement of private philanthropic foundations. One of the earliest of these groups was the Preliminary Committee on Educational Broadcasting (PCEB), which was organized at the 1927 meeting of the NEA department of superintendence. One purpose of the PCEB was to determine the feasibility of the concept of a national "school of the air." The PCEB also requested the Secretary of the Interior to appoint a high-level committee to study the possibilities of instructional radio. In June of 1929, he established the Advisory Committee on Education (ACER) made up of educators and commercial broadcasters. The ACER was funded from two philanthropic foundations: the Payne Study and Experiment Fund and the Carnegie Corporation. The Payne Fund was also involved in several other early educational activities.[38]

On February 15, 1930, the ACER presented its final report to Secretary Wilbur. The report was a list of advantages and

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[36]Ibid., 26.

[37]Ibid., 27-28.

[38]Wood, 25.

disadvantages of educational broadcasting. Prior to this, on November 18, 1929, the American Association for Adult Education met in New York to address concerns that some ACER members might alienate commercial broadcasters. Up to this time, most efforts at adult education by radio had been made through commercial stations. In an effort to promote cooperation between commercial broadcasters and educators, on May 11, 1930, a fifty member National Advisory Council for Radio in Education (NACRE) was appointed. The Rockefeller Foundation and the Carnegie Corporation financed the NACRE.[39]

The NACRE appointed committees in every major field of learning to develop program material and planned to cooperate with colleges, schools, networks, stations, governments, and civic organizations in getting the programs on the air.[40]

About this same time, the Institute for Education by Radio (IER) was founded and held its first conference in Columbus, Ohio, in 1930. Ohio had been using radio extensively in school classrooms. Leaders in educational broadcasting in Ohio observed the growing division among educators over the means of broadcasting. They felt that common ground existed among all educational broadcasters, whether they used commercial facilities or their own stations. The IER continually concentrated on techniques and objectives of educational broadcasting.[41]

A meeting of former ACER members interested in institutionally owned and operated stations met in Chicago on

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[39]Gibson, 31-32.
[40]Ibid., 33.
[41]Ibid., 33-34.

October 13, 1930. This group decided that a national organization was necessary to protect educational stations from extinction. The National Committee on Education by Radio (NCER) was organized and held its first meeting in Washington. D.C. on December 30, 1930.[42]

The NCER addressed an open letter to Congress appealing for independence and freedom for education on the air. The letter described the Radio Corporation of America as a selfish organization and the FRC as generally ineffective. Although the first recorded official request for reserved educational broadcasting channels came out of the 1930 convention of the ACUBS,[43] the NCER letter also urged Congress to pass legislation to preserve a percentage of radio channels for educational broadcasting.[44]

THE EMERGENCE OF EDUCATIONAL TELEVISION

The first experiments with television began in 1874 when Paul Nipkow invented a mechanical system for transmitting views by direct wire. An electronic system to perform the same feat, an iconoscope, was patented by Vladimir Zworykin in 1923. That same year a picture of President Warren Harding was transmitted from Washington to Philadelphia.[45]

Television broadcasting developed entirely under Federal supervision. In the Radio Act of 1927, Congress established the FRC to regulate all forms of interstate and foreign radio

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[42]Ibid., 34-35.
[43]Wood, 30.
[44]Ibid., 37.
[45]Ibid., 114.

transmissions and communications within the United States. According to Public Law 632 from the 69th Congress, radio communications were defined as "pictures or communications of any nature transferred by electrical energy."[46]

Congress established the FRC just in time to regulate television broadcasting. In 1927, the Bell Telephone Company demonstrated a new system in New York City by broadcasting the image of Herbert Hoover for newsmen. In a general order adopted on October 31, 1928, the FRC provided for limited experimentation with television broadcasting on the radio band from 550 to 1500 kilocycles under rigid conditions and hours which would not interfere with radio broadcasting.[47]

During the 1930's, two events occurred which would change the shape of electronic distance education for years to come. The first was the development of FM radio by Edwin Armstrong. (We will discuss FM more later.) The second was the development of television. By 1939, some small commercial TV sets were in production.[48]

During the Depression, beginning in the fall of 1929, commercial revenues from advertising increased, whereas educational stations either closed or reduced their budgets. In the five-year period through mid-1935 local commercial station revenues had more than tripled and network revenues had increased by more than half. There are no comparable statistics for the financing of educational stations as a group, but the three public institutions of higher education in Alabama, for

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[46]Ibid., 114.
[47]Ibid, 115.
[48]Gorelick, 24.

example, gave up their station, WAPI, in 1932 to help pay faculty salaries.[49]

Although there had been experimentation with television apparatus before 1920, it was not until the early 1930's that educational institutions got into the act. Between 1932 and 1934, the State University of Iowa, Purdue University, and Kansas State College (in Manhattan, Kansas) all actually produced experimental teaching programs using the scanning disc method.[50]

The State University of Iowa at Iowa City is usually credited with being the first to actually broadcast educational television (ETV) programs and to have the most extensive early ETV set-up.[51] Station W9XK was licensed to the electrical engineering department of the State University of Iowa.[52] The first educational TV program, presented on January 25, 1933, included a violin solo, a dialogue, and a lesson in freehand sketching. In a lecture in March, 1933, E. B. Kurtz, head of the electrical engineering department and director of the ETV project, said, "Just one word on the place of television in our broadcasting system. In my opinion it is not only to be a complement to radio but it is going to be radio's 'better half'." Between 1932 and 1939, W9XK would present a total of 389 educational broadcasts, primarily on an experimental basis. Gradually, the university's experimental television projects

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[49]Blakely, 55.
[50]Wood, 28.
[51]Ibid., 28.
[52]Gibson, 115.

turned to electronic scanning. The last telecast of W9XK was on June 29, 1939 when it became W9XUI.[53]

Despite this fact, in 1938, the National Broadcasting Company arranged a demonstration of the use of television in college classrooms. David Sarnoff, president of the Radio Corporation of America, observed as early as 1930 that with television, educators could break the confining walls of the American home and bring forces that would stimulate higher standards. In 1936, the National Advisory Council on Radio in Education noted experiments with educational television. The organization published a pamphlet to keep educators informed of technical developments in television broadcasting. At a hearing of the FCC in 1936, John W. Studebaker, U.S. Commissioner of Education stated that "television has definite educational possibilities." At the First National Conference on Educational Broadcasting in 1936, FCC Chairman Anning S. Prall emphasized the commission's awareness of the tremendous possibilities of television for educational broadcasting.[54]

The 1930's represented an evolutionary step from sound (radio) to sound and moving picture (television). Yet television would not become viable to distance education until the late forties. By 1936 theoretical research and practical experimentation demonstrated that areas of the radio spectrum previously unused because of technical limitations might be utilized for the expansion of existing services and the institution of new services. Other technical developments during this time included new radio channels for other than broadcast services, allocation of new channels for standard AM broadcasting, visual broadcasting, and broadcasting above the

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[53]Wood, 28.

[54]Gibson, 116-117.

standard AM band.[55] Experimenters with visual broadcasting asked that provision be made for continued experimentation with television but asked that it not be commercialized until fully perfected.[56]

On April 30, 1939, NBC began regular program service over its experimental station W2XBS by televising Franklin D. Roosevelt as he opened the World's Fair in New York City. At the same time, Allen B. Dumont began manufacturing television sets and sold about one thousand in the New York area during the first year of sales.[57]

RETRENCHMENT IN RADIO

In the mid 1920'S, only half of the educational institutions that held broadcast licenses actually had stations on the air. By the mid-1930'S, the percentage of active licensees had further reduced. Up to 1936, a total of 202 broadcast licenses had been issued to educational institutions, but only thirty-eight educational AM radio stations were actually on the air. Not until the late 1940's and early 1950's, with widespread utilization of FM frequencies, did educational radio begin to fulfill its early promise.[58]

The National Committee on Education by Radio (NCER) founded in 1931 lasted until 1941 as a powerful vehicle for unifying educational radio activities and concerns. One major influence of NCER was the prodding of the FCC to live up to the

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[55]Ibid., 85.
[56]Ibid., 86.
[57]Ibid., 118.
[58]Wood, 18.

requirements of the Communication Act of 1934 which required the FCC to study the question of assigning a fixed percentage of radio frequencies to education.[59]

The National Advisory Council on Radio in Education (NACRE) was active in many areas that helped to pull all educational broadcasters in a unified direction. These areas included research, demonstration projects, and conferences. NACRE was disbanded in 1938 when the Rockefeller Foundation withdrew its financial backing. The disbandment of agencies and projects when sponsoring foundations changed their priorities was a repeated occurrence during this time period.[60]

The situation seemed increasingly bleak for the ACUBS as for all educational broadcasting especially during the early 1930's. Money problems were increasing, membership was decreasing, the FRC did nothing to encourage noncommercial radio, and educators were turning more frequently to commercial broadcasters for the opportunity to present their programs over adequate facilities. At a special meeting called in the fall of 1934, the ACUBS changed its name to the National Association of Educational Broadcasters (NAEB). This and other changes were designed to attract new members. The new NAEB included not only college and university stations but also any educational institution that broadcast regularly over commercial stations.[61]

On December 20, 1935, the Joint Radio Project (JRP) was established. It was financed by funds set aside for the President's use in fighting the Depression. The JRP recruited

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[59]Ibid., 27.
[60]Ibid., 26.
[61]Ibid., 23-24.

writers, researchers, announcers, actors, directors, and producers from relief rolls. The main objective of the JRP was to demonstrate to educational broadcasters effective use of program material and broadcasting techniques. The JRP became the Educational Radio Relief Project (ERP) of the Office of Education in July, 1937.[62]

The Federal Radio Education Committee (FREC) was founded in 1935 and held its first general meeting on February 17 and 18, 1936. At this meeting, the FCC announced again that the object was to eliminate controversy and misunderstanding between groups of educators (such as NCER and NACRE) and between the industry and educators, and to promote actual cooperative arrangements between educators and broadcasters.[63]

In Detroit, in 1936, a small, local philanthropic agency, the Ford Foundation, was created. Once the Ford Foundation entered the picture, educational radio and television had a benefactor that overshadowed all others. It would be a foundation willing and able to pour hundreds of millions of dollars into educational broadcasting.[64]

From 1935 until the start of World War II, the programming of radio was marked by increasing commercialization. Many local stations and all the networks turned programming responsibilities over to sponsors and advertising agencies, and audience ratings became increasingly important.[65]

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[62]Gibson, 75.
[63]Ibid., 72.
[64]Wood, 28.
[65]Blakely, 76.

THE DEVELOPMENT OF FM RADIO

During congressional debate preceding the establishment of the Federal Communications Commission (FCC) in 1934, the question of reserving channels for education was raised again.[66] On June 9, 1934, Congress passed a bill which abolished the FRC but reenacted the Radio Act of 1927 as Title III of the law. The bill neither allotted a percentage of channels for nonprofit organizations nor required the FCC to study the proposition. The Communications Act of 1934 became effective on July 1. The act abolished the FRC, repealed the Radio Act of 1927, and established the FCC.[67]

The FCC was anxious to be of aid to anyone using radio for educational purposes. A conference to work out a plan of cooperation among broadcasters opened on May 15, 1935. The FCC announced at the conclusion of the two-day meeting that it would appoint a Federal Radio Education Committee (FREC) composed of commercial and educational broadcasters to study plans to obtain more time for purely educational programs.[68]

On June 15, 1936, at an informal engineering hearing held by the FCC, developers of broadcasting by frequency modulation (FM) explained the technical aspects of their experiments and asked that radio channels for FM broadcasting be reserved for their use when commercialization became practical in the future.[69]

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[66]Wood, 30.

[67]Gibson, 55-56.

[68]Ibid., 70-71.

[69]Gibson, 86.

On January 26,1938, the FCC made an unexpected and unprecedented move. On that day, the FCC adopted a set of rules governing a new class of stations called "noncommercial educational." Although this class of stations was intended as AM, it set a precedent which would soon provide a launching pad for the educationally favorable FM. A noncommercial educational station license would be granted to any organized nonprofit educational agency which showed that the station would be used for the advancement of its educational program. The FCC allocated twenty-five channels for the exclusive use of this class of stations. No one had ever broadcast on these AM channels. Transmitters and receivers were not available. Equipment would have to be made to specifications.[70]

Less than a month after the FCC announcement, the Cleveland Board of Education applied for and got a license. After a year, the Cleveland station issued a report on its activities and described how to plan, install, and operate an ultra-high frequency educational broadcasting system.[71]

From March 18 to March 29, 1940, the FCC held a hearing on FM broadcasting. In its Report and Order 67, dated May 20, 1940, the FCC established FM broadcasting on a limited basis immediately and on a full basis January 1, 1941. Because of its restricted range and coverage, FM was not expected to supplant AM broadcasting, but the FCC did expect a great public demand for FM.[72]

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[70]Ibid., 91-92.
[71]Ibid., 93.
[72]Ibid., 97.

On June 27, 1945, the FCC allocated and reserved for noncommercial educational stations the first twenty of the one hundred FM channels between 88 and 108 kilocycles. (Take a good look at your FM radio and notice the numbers on the selector dial.) The educational channels between 88.1 through 91.9 have remained exclusively noncommercial FM radio until the present. The FM radio channel reservations are on a block or "cluster" basis; that is, these twenty channels are reserved everywhere across the country.[73]

Many educators had become interested in the new frequencies. Rather than pay a high price for specially-built AM transmitters, educational broadcasters could buy standard competitively produced FM transmitters at a saving.[74] The first educational FM station, WBOE in Cleveland, had gone on the air in 1941. By the end of 1945, there were six FM educational stations.[75]

Educational broadcasting was once again off to a good start. Unfortunately for FM, two events became roadblocks to its growth as a distance education medium. The first was the discontinuance of the ERP, the Depression recovery program for radio. The second was World War II.[76]

During the war, the FCC received several hundred applications for licenses for commercial FM stations. Probably thinking that there would be plenty of time after the war was over to make plans for educational broadcasting, educators did

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[73]Wood, 32.
[74]Gibson, 95.
[75]Wood, 32.
[76]Gibson, 98.

not make applications during the war for educational stations. The U.S. Office of Education (USOE) began a campaign to arouse concern for postwar educational broadcasting. In 1944, the Office of Education published a booklet, FM for Education, discussing educator's plans for the use of radio in the postwar period.[77]

FM equipment was used extensively by the armed forces of the United States during World War II. Immediately after the war much of this equipment was declared surplus government property. Under the auspices of the FCC, school officials and representatives of the USOE and the Surplus Property Board met in Washington to discuss ways and means of using surplus military equipment for educational broadcasting. Educational broadcasters were allowed to purchase surplus equipment as soon as it became available, so that they could modify their facilities and begin broadcasting. Twenty-four educational stations received FCC authorization within a year after the 1945 allocation plan became effective.[78]

The FCC issued its proposed rules for educational FM stations on March 7,1946. Effective May 1, 1948, the FCC extended the normal licensing period for noncommercial educational FM stations to three years. This was a saving in time and expense to educational broadcasters who had previously been required to renew their licenses annually. On June 16, 1948, the FCC issued a notice of proposed rulemaking establishing ten watt noncommercial educational FM broadcasting stations as a new classification of educational stations.[79]

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[77]Ibid., 99-100.
[78]Ibid., 105-106.
[79]Ibid., 106,109-110.

This action, which resulted in low equipment and operating costs, was a deliberate effort to encourage educational FM broadcasting.[80]

THE AWAKENING POTENTIAL OF TELEVISION

RCA began a large-scale advertising campaign on March 20, 1940, to promote the sale of its television receivers. The FCC had established no set of standards for television engineering practice and would permit three different systems to experiment with program production.[81]

The reservation of radio channels for educational stations was only a small part of the struggle over the uses of the frequencies higher than 25 megacycles. The anticipation was that these frequencies would be used for television. The allocation of frequencies and the licensing of stations for FM radio came into conflict with the demands for television on two fronts: a space in the spectrum and resources for research and development. The FCC faced two sets of questions: (1) what channels to allocate for FM and what for television and where to place them? and (2) what standards to require for television and when to set them? On April 30, 1941, the FCC adopted the standards recommended by the National Television System Committee. It allocated to television eighteen VHF channels and authorized full commercial operations on these channels.[82]

Before educators were ready to plunge fully into initiating their own television operations, there had to be a period of

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[80]Blakely, 79.

[81]Gibson, 119.

[82]Blakely, 74-75.

experimentation. In 1942, one of the earliest educational uses of the new medium was the training of air raid wardens in New York City using the experimental RCA station.[83]

World War II gave the FCC a respite. Research developments in electronics during the war contributed significantly to the development of television making the 1941 version of television obsolete. The question of television standards had been reopened.[84] The war halted production of transmitters and sets before commercial television operations could get started, although during the war many technical advances were made in both TV and FM.[85]

On June 1, 1944, eight years after he expressed the hope that the FCC would serve the purpose of education in television, John W. Studebaker, Commissioner of Education, formally requested the FCC to reserve two channels for education.[86] At FCC hearings held in 1944 there was still little evidence to warrant a reservation of television channels for educational purposes.[87] Studebaker's was the only voice requesting television channels for education.[88]

In a preliminary television allocation report on January 15, 1945, the FCC stated that educator interest in television did not warrant an immediate reservation of channels for education. In its final television allocation report on May 25,

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[83]Wood, 29.
[84]Gibson, 121.
[85]Blakely, 75.
[86]Gibson, 121.
[87]Blakely, 78.
[88]Gibson, 121-122.

1945, the FCC bowed to public clamor and pressure from commercial broadcasters and manufacturers by making available thirteen channels in the VHF range for commercial television.[89] In 1945, the FCC said it would take up the matter of educational television channel reservations when educator interest was aroused.[90]

On March 18, 1947, the FCC resumed television licensing which had been interrupted by World War II. It reserved no channels for noncommercial educational stations because educators still had expressed little interest.[91] Yet later in 1947, the Philadelphia public school system, under the leadership of Martha Gable, began a weekly series of classroom instructional programs over three local commercial stations. And in 1948 there were at least eight colleges and universities involved in educational television programming.[92]

After another hearing on May 5, 1948, the FCC deleted channel one from television service. This channel was assigned to nongovernmental fixed and mobile radio services. The FCC also eliminated the sharing of channels two through thirteen by non-television services.[93]

The year 1948, generally marked the awakening of educational broadcasters to the potentials of television. Many of them began to realize that they must move fast or television

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[89]Ibid., 122-123.
[90]Ibid., 127.
[91]Blakely, 1.
[92]Wood, 29.
[93]Gibson, 125.

would be completely dominated by commercial interests.[94] In 1948, a small handful of progressive NAEB leaders, looking forward to the potential of television, began to explore the use of television in education.[95] Since by 1948, the major VHF channels were already committed to commercial interests, the UHF band seemed to the NAEB leadership to represent the best opportunity for educational television. At he 1948 NAEB convention, a resolution was adopted urging the FCC to reserve certain ultra-high frequency channels for educational and non-profit purposes. This resolution was based on the precedents of the 1938 and 1945 FCC reservation of FM channels.[96]

In contrast, the commercial broadcaster's drive to get television licenses and put stations on the air was like a gold rush. During 1948 alone, the number of television stations on the air increased from seventeen to forty-one.[97] During the year following the resumption of television licensing by the FCC, the volume of allocations was causing much interference in the reception of television signals. The twelve VHF channels would be far from enough to meet the demand and UHF and color questions needed further study.[98]

On September 10, 1948, the FCC issued the Report and Order that was to become known as the "freeze order," suspending all

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[94]Wood, 32.

[95]John A. Curtis and Joseph M. Biedenbach, eds., Educational Telecommunications Delivery Systems (Washington, D.C.: American Society for Engineering Education, 1979), 10.

[96]Wood, 33.

[97]Blakely, 1.

[98]Ibid., 75.

action on station licenses and applications while the FCC revaluated its earlier assignments and began debate on UHF and color television.[99] Therefore, on September 29, 1948, the FCC stopped processing applications for television stations for a while beyond the 108 licenses it had already granted (including license number 100 granted to Iowa State College).[100]

THE DEVELOPMENT OF EDUCATIONAL TELEVISION

On July 8, 1949, the summer following the freeze order, the FCC announced a new round of hearings encompassing all the problems facing the industry and especially the nationwide allocation of television channels.[101] As a result of these hearings, the FCC issued a Notice of Further Proposed Rule Making, which allocated 2,245 stations in 1,400 different communities. There were no reservations for any noncommercial educational television stations.[102]

Frieda B. Hennock, appointed to the FCC on May 24,1948, previously a corporation lawyer and leader in the liberal wing of the Democrat Party[103], was the only one of seven FCC commissioners who dissented from the Notice. She vehemently pointed out the need to reserve a portion of the television spectrum for the educators, whether or not they were organized, well financed, or farsighted enough to know what they would do with the channels. Eventually the need would be there, she argued, but the channels would be gone, all assigned to

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[99]Wood, 34.
[100]Blakely, 75.
[101]Gibson, 129.
[102]Wood, 37.
[103]Gibson, 129.

commercial broadcasters.[104] This individual FCC commissioner, who is credited with almost single-handedly guaranteeing that there would be channels reserved for educational television, stated that "educational stations will provide the highest standards of public service."[105]

Meanwhile, coincidental with the action over the FCC consideration of reservations, two historic seminars were held at Allerton Park in Urbana, Illinois, during the summers of 1949 and 1950. These seminars, which brought together leaders in educational broadcasting, were cosponsored by the Rockefeller Foundation and the University of Illinois Institute of Communications Research. Although the Allerton House seminars were primarily directed toward radio development, the motivation, sense of excitement, and responsibility instilled at the seminars were carried into television.[106]

The seminars stated the purposes of educational broadcasting in such a way as to help educational broadcasters, educators, scholars, and government officials define common goals. They also explored new ways of advancing education through broadcasting.[107]

FCC hearings on the problem of color television began on September 26, 1949 and continued until the commission accepted the CBS standards for a color system on October 10, 1950. At the same time, the FCC began hearings on other questions

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[104]Wood, 37.
[105]Ibid., 3.
[106]Ibid., 37.
[107]Blakely, 10.

pertaining to educational television including allocating channels for education.[108]

When the FCC announced that it would resume its television hearings on October 2, 1950, and scheduled testimony concerning the reservation of television channels for educational television, Frieda Hennock stepped up her crusade. She felt that educational stations would stimulate competition to provide better programs on commercial stations.[109]

At this point I have encountered some conflicting information. In late 1950, the NAEB was instrumental, following the suggestion of Dr. Franklin Dunham, Chief of Radio-Television for the USOE, in calling together educational groups interested in the FCC allocation activities. This meeting was held on October 16, 1950. According to Wood and Wylie[110], this meeting was held at the home of Frieda Hennock. According to Gibson[111], this meeting was held in the office of Dr. Dunham.

Nevertheless, everyone agrees that this meeting was the first meeting of the ad hoc Joint Committee on Educational Television (JCET). Its purpose was to plan and coordinate the testimony to be given to the FCC.[112] The early activities of the JCET were to profoundly shape educational broadcasting for years to come. One of the first accomplishments of the JCET was to reach compromises on the basic differences that separated the various groups interested in educational television.[113]

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[108]Gibson, 131.
[109]Ibid., 133.
[110]Wood, 42.
[111]Gibson, 134.
[112]Ibid., 134.
[113]Wood, 42.

The educational television phase of the FCC hearing lasted from November 27,1950 until January 31, 1951. The supporting witnesses appeared for the JCET which represented seven national education groups including the NAEB and the NEA. Attorneys for JCET requested the FCC to reserve television channels for educational stations to provide programs to schools, and cultural, educational, and entertainment programs for a general audience.[114]

The FCC favored noncommercial educational broadcasting and approved, in principal, educational television. Commercial broadcasters felt that each application for a VHF channel should be considered on its own merit. There was no objection to educator's being assigned UHF channels. It seemed clear that commercial broadcasters equated VHF television with AM radio and UHF television with FM radio. VHF and AM were firmly established as the media for mass communication, while UHF and FM were thought of as media for specialized audiences. Resolutions in the House of Representatives and Senate directing the FCC to study the allocation of channels for educational purposes added impetus to the drive. Commissioner Hennock maintained the momentum of her crusade.[115]

On March 22, 1951, the FCC announced its proposal to reserve 209 television channels for noncommercial education stations.[116] Included in this decision was a plan to add seventy UHF channels to the existing 12 VHF channels. The 209 noncommercial educational television channels would be assigned

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[114]Gibson, 135-136.

[115]Ibid., 138-139.

[116]Blakely, 79.

to VHF and UHF.[117] This proposal of the FCC was the first formal step toward withdrawing a significant part of the broadcasting spectrum from the commercial broadcasters.[118]

Also on March 22, the JCET was formally established. The Committee received an initial grant of $90,000, from the Fund for Adult Education of the Ford Foundation, to give legal assistance to educational broadcasters in preparing written comments and countercomments to the FCC assignment plan.[119] In its final report and order on April 13, 1952, adopting the tentative proposal, the FCC replied that educational institutions must move slowly. In a dissenting opinion, Commissioner Hennock concurred with the decision, as it adopted the principle of reserving channels for educational purposes, but dissented insofar as it failed to make a more adequate and proper promise for education.[120]

This report, entitled the Sixth Report and Order was the document which ended the freeze. The decade following the report was largely a period of steady growth, maturation and slow evolution. The first noncommercial television station went on the air in 1953. Nine years later there were seventy-four educational television stations broadcasting.[121]

Out of the 1949 Allerton House seminars to establish an educational radio network came the idea to found a nationwide educational television network. During 1952 support for the

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[117]Gibson, 140.
[118]Blakely, 27.
[119]Gibson, 141.
[120]Ibid., 143-144.
[121]Wood, 45.

network idea came from USOE, the American Council of Education, and Paul A. Walker of the FCC. On November 21, 1952, with the financial support of the Fund for Adult Education, The Educational Television and Radio Center (ETRC) was incorporated to exchange, evaluate, publicize, research, and create or acquire programs for distribution to noncommercial television and radio stations. Regular network service began on May 16, 1954.[122] For almost twenty years, this organization played one of the key roles in the development of noncommercial educational television, at times being the undisputed kingpin. The ETRC programming service (later called the NET) was officially launched to the four noncommercial educational television stations then on the air. This service consisted of five hours of programming a week which were circulated, through the mails, to stations on a round-robin basis.[123]

On March 15, 1957 the Senate Committee on Interstate and Foreign Commerce which was to watch over the educational assignments met with the FCC commissioners to discuss educational television. Some of the commissioners said that channels should not be reserved indefinitely. Senator A. S. Mike Monroney said to let commercial stations have any educational assignments would be "robbery of coming generations." Senator William A. Blakley said the channels should be reserved "indefinitely." The threat of congressional action against the FCC through appropriations and appointments was unspoken, but the FCC go the point. In 1957 and 1958, the FCC denied petitions to change educational assignments in Florida, North Carolina, Connecticut, and Texas.[124]

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[122]Gibson, 146-147.

[123]Wood, 47-48.

[124]Gibson, 155.

On March 17, 1957, Warren G. Magnuson introduced a bill in the Senate authorizing the appropriation of one million dollars to each state and territory to provide educational television facilities. On April 24 and 25, the Senate Committee on Interstate and Foreign Commerce held hearings on the bill. The Senate passed the bill on May 29, 1958. The House version, the same as the Senate bill, became swamped in a jam of legislation at the end of the eighty-fifth Congress. During that session, however, Congress passed the National Defense Education Act of 1958. Title VII (Educational Media Research) of the act authorized an expenditure of Federal funds "through grants or contracts to conduct, assist, or foster research and experimentation in the development and evaluation of projects involving television, radio, and motion pictures which may prove to be of value to elementary, secondary, and higher education and in the development of new and more effective techniques and methods for utilizing television, radio, and motion pictures, for training teachers, and for presenting academic subject matter." (Public Law 85-864, 85 Cong.) Congress appropriated $500,000 for such research and experimentation in the first year of the act.[125]

On February 19 and 20, 1959, a subcommittee of the House Committee on Education and Labor held hearings to determine public response to the National Defense Education Act. Because the demand was so great and proposals so worthy of consideration, they urged Congress to appropriate more money for educational media research.[126]

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[125]Ibid., 160-163.

[126]Ibid., 163.

On June 26, 1956, the FCC called a meeting of television broadcasters and manufacturers for August 20 to establish the Television Allocations Study Organization (TASO). The organization reported the results of its research on March 16, 1959. The FCC requested Congress to pass a law requiring all television receivers shipped in interstate commerce to be capable of receiving UHF channels as well as VHF.[127]

EARLY EDUCATIONAL TELEVISION ACTIVITIES

In 1958, the USOE issued a pamphlet called Television and Education which sweepingly endorsed educational television as a giant force waiting to be developed.[128] The number of educational television stations increased from twenty-two to seventy-six between the end of 1956 and the end of 1962.[129]

The term "telecourse" was coming into general usage in 1950. The term referred to an educational program for which viewers could register and receive some sort of certificate for participation. The University of Michigan was one of the earliest institutions to engage in this type of programming, incorporating the telecourses into its University of Michigan Hour, starting November 5, 1950, over Detroit commercial station WWJ-TV. Western Reserve University is usually given credit for the nation's first continuous series of full-credit college courses to be taught on television. It started telecasting its Introductory Psychology course in September 1951, for college credit over station WEWS in Cleveland. A USOE survey of the period showed that during the 1952-53 academic year, ninety

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[127]Ibid., 157.
[128]Ibid., 158-159.
[129]Blakely, 117.

commercial stations were carrying a total of 256 different educational television series of one type or another.[130]

Still, in the United States, educational programs were, more often, created to provide information rather than offer educational credits. A notable exception was Sunrise Semester, created by CBS and New York University. Using the traditional lecture, Sunrise Semester was first shown in 1957. The format of two college courses and two semesters was retained during the twenty-five years the program was on the air. It survived the move to color television and went from live programs to videotape. Students paid a fee, read their texts, completed assignments, and received college credit. But the program was not able to survive when expensive, professional programs began to appear. Sesame Street became the guideline for learning via television.[131]

During the next two decades following 1950, the Ford Foundation was to become the single greatest benefactor of the entire educational television movement. A conservative estimate is that during this period, the Ford Foundation provided the educational movement, directly or indirectly, with about $300 million. The foundation outlined two main areas of concern: formal in-school instruction and less formal general adult education. It created two separate funds, one for each area. They were the Fund for the Advancement of Education and Fund for Adult Education.[132]

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[130]Wood, 38.

[131]Claire M. Stern, "Teaching The Distance Learner Using New Technology," Journal of Educational Technology Systems 15, no. 4 (1986-87): 408.

[132]Wood, 39.

One significant project of the late 1950's was the National Program in the Use of Television in the Public Schools, supported by the Fund for the Advancement of Education. It was not a single project, but a series of loosely related autonomous research endeavors. Starting in 1957, ten school districts and other individual schools participated in similar research projects. By 1959, a total of twenty major centers were participating in various aspects of the program.[133]

By the end of the 1950's, sixty or more educational television stations were beaming instructional programs into thousands of classrooms across the country. A wide variety of school television activities had been undertaken in this decade of development. At least 500 separate closed-circuit systems were operating by the early 1960's.[134]

AND NOW HERE'S CABLE TELEVISION

Community Antenna Television (CATV) was first established in 1949 in remote areas of Pennsylvania and Oregon. The concept was a simple one: Television signals could be provided in areas of poor reception by using an antenna sufficiently high enough to receive a remote broadcast signal, and then redistributing the signal via coaxial cable to subscribers who could not otherwise receive a good signal on a home-type antenna. For this service, subscribers were willing to pay a fee. An entire community could be served from one master antenna. CATV's birth and growth pattern has been the reverse of almost every other American technological innovation. Cable began in remote rural

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[133]Ibid., 52-53.

[134]Ibid., 53.

areas, expanded into the suburbs, and then penetrated urban areas.[135]

Most of the early systems were small rural ones, which transmitted commercial broadcast signals of one to three stations. Until 1953, technical capacity limited cable transmission to no more than five channels. After 1953, twelve channel capacity, the same as a standard television receiver (VHF) became available. By the 1960's, paired with microwave technology, cable was able to import long distance, multi-program signals. This was a real threat to big city commercial broadcasters who up to this time welcomed cable as a way to extend their service for a fee. But microwave transmitters required FCC licenses. This began regulation of CATV by the FCC. By 1966, the FCC asserted its jurisdiction over all cable systems including local signals.[136]

For over a half century broadcasters and educators have worked with each other in an attempt to produce and deliver informational and educational programs, starting with radio in the 1920's, followed by television in the 1940's, and by cable television in the 1950's. These programs were all one way, from the studio to the learner. As two-way, interactive capability on cable television, microwave, and even satellite transmission became a reality, educators and managers also became more attentive to the possibilities of teaching the distance learner in and out of the traditional classroom.[137] Cable television was possibly the beginning of a confluence of technologies

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[135]Curtis, 105.
[136]Ibid., 107.
[137]Stern, 407.

leading to hybrid systems for delivering electronic distance education.

TOWARD NEW IDENTITIES AND ORGANIZATIONS

The early 1960's marked a period of rapid growth for noncommercial educational television both in terms of the number of stations on the air and of the numbers of hours those stations transmitted programming to serve their local communities. Federal facilities grants and Ford Foundation financial support were pivotal during this decade.[138]

Two federal laws enacted by mid-1962 improved the educational television situation in important ways. The Educational Facilities Act provided money to activate and expand educational television stations. The All-Channel Television Receiver Act eventually increased the number of receiving sets on which viewers could receive UHF signals.[139] The Educational Television Facilities Act was the first direct federal support of public broadcasting.[140]

Several Federal programs provided funds for distance learning hardware. The Public Telecommunications Facilities Program at the National Telecommunications and Information Administration, established in 1962, has funded the purchase of equipment used in distance learning efforts.[141]

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[138]Curtis, 11.

[139]Blakely, 143.

[140]George W. Tressel and others, The Future of Educational Telecommunication: A Planning Study (Lexington, Mass.: Lexington Books, D. C. Heath and Company, 1975), 5.

[141]Congress of the United States, Linking for Learning: A

NEW TECHNOLOGIES AND DEVELOPMENTS

In the 1940's, Westinghouse had experimented with the possibility of relaying television signals from an airplane (this was before transcontinental cable was laid). In the late 1950's, the idea was revived with a $7 million grant from the Ford Foundation. The Midwest Program on Airborne Television Instruction (MPATI) was created.[142]

Twenty universities in a six-state area were selected as "resource institutions" for MPATI. In September 1961, the project literally got off the ground, and the most expensive and best produced instructional television telelessons created up to that point were transmitted into classrooms across the region. At its peak, MPATI enrolled close to 2,000 individual schools. The project had two problems. First, the project could not get the four to six permanent UHF channel assignments it requested. Second, MPATI succeeded in stimulating enough interest in educational television throughout the six-state region that it helped put itself out of business. Thus, in 1968, the airplanes came down for the last time.[143]

The development by 1938 of a long coaxial cable which can transmit several signals on a single line and the development by 1945 of microwave transmission which can send directional signals through the air were landmarks in the capability of

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New Course for Education (Washington, D. C.: Office of Technology Assessment, 1989), 15,18.

[142]Wood, 205-206.

[143]Ibid., 208.

using television over large areas for many purposes including instruction. Many schools, however, adopted closed-circuit television and Instructional Television Fixed Service, both especially suited to instructional television because they can be aimed at precise audiences.[144]

INSTRUCTIONAL TELEVISION FIXED SERVICE

In the 1960's, three major hardware breakthroughs were to make possible additional school applications of educational telecommunications. These were Instructional Television Fixed Service (ITFS), slant-track video recorders (VCR), and random access systems. I would like to discuss ITFS further. ITFS has a limited range, but it still qualifies as a distance education medium in that it is well suited to a campus situation with dormitories, for example.

In July 1963, the FCC authorized establishment of the Instructional Television Fixed Service (ITFS). The ITFS reservations included thirty-one (now twenty) different channels limited to educational users. The primary advantage to the ITFS system is that any single licensee can apply for up to four different channels making multichannel service possible.[145]

The normal range of ITFS is twenty miles and requires direct line-of-sight to operate. Receiving antennas must be precisely aligned to receive the signal. The most common use of ITFS is delivery of one-way video to schools with telephone hookups for two-way audio.[146] In addition to its function of

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[144]Blakely, 138-139.

[145]Wood, 61.

[146]Congress, 62.

distributing specialized materials to limited audiences, ITFS provides a means to transmit instructional material to classrooms without the level of expense required for a conventional educational TV station.[147]

COMMUNICATION SATELLITES

The communications satellite added another dimension to the technology of electronic interconnection. Previously the only alternative to wire or cable connection over long distances was relay repeater stations. Relay by space satellites overcomes previous earth bound difficulties because their line-of-sight signals can be transmitted over one-third of the earth. As larger and more "active" satellites were developed, they could amplify, modulate, and focus signals, permitting the ground stations to be simpler and cheaper. When the synchronous satellite was developed (one that circles the earth at exactly the same speed of the earth's rotation) was "parked" in an apparently stationary orbit, it could be used around the clock by all the earth stations within its line of sight. Three synchronous satellites can give continuous worldwide relay transmissions because each satellite is in constant line of sight to earth stations in one-third of the planet and each satellite is in constant line-of-sight to the other two satellites.[148]

In December 1958, the first U.S. communications satellite was launched. In April 1962, a space satellite transmitted the first television picture from California to Massachusetts. In July 1962, Telstar I, was launched and paid for by AT&T. It

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[147]Tressel, 25.

[148]Blakely, 157.

gave the first reliable transatlantic television transmission.[149]

In 1961 and 1962, a committee of the FCC and committees of both the House and Senate held long hearings on the support, ownership, operation, and regulation of communication satellites. On August 31, 1962, Congress adopted the Communication Satellite Act which established a hybrid public-private commercial corporation, with half of the common stock reserved for authorized common carriers (such as AT&T and RCA) and half for general public investors. After the Communications Satellite Act was passed, rapid technological progress continued.[150]

1967: A MAJOR TURNING POINT

The FCC had issued a Notice of Inquiry in 1966 for interested parties to express their views and comments "in the matter of the establishment of domestic non-common carrier communication-satellite facilities by non-government entities." The Ford Foundation was the first agency to respond. It presented its preliminary proposal in late 1966. The Ford plan called for the establishment of the "Broadcasters' Non-Profit Satellite Service."[151]

In 1964, at a conference held by the NAEB and the U.S. Office of Education, Mr. Ralph Lowell proposed the establishment of a commission to analyze the financial needs of educational television and suggest how funding requirements might be set.

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[149]Ibid., 157-158.

[150]Ibid., 158.

[151]Wood, 66.

This proposal stimulated the establishment of the Carnegie Commission on Educational Television and the issuance of its report, Public Television - A Program for Action, in January of 1967.[152]

It is no exaggeration to state that this report has been the most influential private document on noncommercial broadcasting released. The essence of the Carnegie Commission report was a series of twelve far-reaching recommendations[153], covering the establishment of a "Corporation for Public Television"; increased federal, state, and local financing; the creation of two major national production centers; live interconnection; uses of improved technology; increased research; federally guaranteed support for the corporation; more federal funds for educational television facilities; more attention for uses of television in formal education; and various avenues of support for local educational television stations.[154]

The term "public television" was popularized by the Carnegie Report in 1967, and it was quickly broadened to "public broadcasting." The terms "public radio" and "public television" now refer specifically to the two media involved in "public broadcasting".[155]

Seldom have the gears of federal government turned quite so expeditiously in churning out legislation for a completely new

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[152]Tressel, 5.

[153]See Appendix B for the text of the twelve recommendations.

[154]Wood, 65.

[155]Ibid., 5.

program, especially one that was not a response to a national crisis. The Carnegie report was issued in late January 1967. President Johnson submitted his proposed Public Broadcast Act to Congress in March. The Senate passed the bill; the House passed its version; a compromise version was worked out and passed by both Houses; and President Johnson signed the bill into law on November 7, 1967.[156] A little more than nine months after the report was first issued, Congress quickly passed the act because there was little organized opposition to it by the commercial broadcasting interests.[157]

This act radically changed the components of and institutional relationships in educational broadcasting in the United States. It had far-reaching and long-lasting implications for the entire American system of mass communications and the entire American educational system.[158]

The Public Broadcasting Act of 1967[159] expanded some of the Carnegie Commission's proposals to include radio, and it mandated a federally supported organization to, among other things, facilitate the full development of educational radio and television, including its uses in instruction. Title III of the legislation called for an extensive examination of all instructional media, including television and radio.[160]

The crux of the Public Broadcasting Act was the middle part which established the Corporation for Public Broadcasting (CPB).

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[156]Ibid., 66.

[157]Blakely, 181.

[158]Ibid., 175.

[159]See Appendix C for the full text of the Act.

[160]Wood, 11.

The CPB was created to facilitate the full growth and development of non-commercial, educational radio and television nationwide.[161] Although the CPB was authorized by the end of 1967, it was still a year or so before it could become fully operational and establish the other entities that would fulfill the promise of the Public Broadcasting Act of 1967.[162]

In January 1969, the CPB announced that it would oversee a six-month trial interconnection among most of the public television stations, taking advantage of special reduced rates which the CPB and the FCC had worked out with AT&T. In April 1969, the Ford Foundation and the CPB made a joint statement in effect signaling that the foundation was yielding leadership to the corporation.[163]

Even though it was conceivable that some existing organization such as the NET could serve as the television network for the CPB, the new corporation and station representatives chose instead to create a new entity, the Public Broadcasting Service (PBS).[164] PBS was established solely as the networking agency. Its functions were to select, schedule, and distribute network programming over the interconnection. PBS was not to be a production center.[165] Since its inception in 1969, PBS has been broadcasting and delivering by satellite enrichment programming, teacher teleconferences, documentaries, and one-way courses to schools.[166]

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[161]Curtis, 9.
[162]Wood, 67.
[163]Blakely, 200.
[164]Wood, 67-68.
[165]Ibid., 68.
[166]Congress, 41.

Since the scope of the CPB included radio, it was apparent that a parallel radio network should also be established. So, National Public Radio (NPR) was created, and the interconnected public radio network was initiated in May 1971. NPR differs from its television counterpart in at least two significant ways. First, NPR is a producer as well as a distributor; it produces much of its own programming, especially in the public affairs area. Secondly, NPR makes some specific grants directly to the public radio stations. It receives the funds from the corporation, then actually specifies them for individual station projects. PBS, on the other hand does not make direct grants to individual public television stations with CPB dollars. The stations receive television grants directly from the corporation.[167]

A PERIOD OF BUILDING ON EXISTING FOUNDATIONS

In 1973, eleven years after the first federal funding and six years after the Public Broadcasting Act of 1967, educational radio and television began to mature and develop a character of their own. Public radio stations were generally operated by colleges and universities, but public television stations were divided among educational agencies, state agencies, and nonprofit community corporations.[168]

The number of noncommercial educational television stations had grown steadily since 1953.[169] As of July 1, 1973, there

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[167]Wood, 68.

[168]Tressel, 1.

[169]See Appendix F which shows a map indicating noncommercial television coverage in 1971.

were 238 educational television transmitters operated by 148 licensees. Of the 238 transmitters, 94 broadcast on VHF and 144 on UHF.[170]

Educational broadcast facility interconnections were constantly being developed and improved. A single television broadcast required the channel space of a thousand radio programs. Electronic interconnection was imperative for real-time broadcast flexibility. Interconnection was the lifeblood of broadcasting. A quarter million dollars per hour was a fairly common investment in commercial television documentaries, and few public stations could match this quality of programming without the economies of network distribution. A prime goal of the Public Broadcasting Act of 1967 was to bring this potential to educational broadcasting, while maintaining the options for local programming and flexibility.[171]

Educational use of ITFS focused on the communication of information and interactive teaching and learning. It did not compete with commercial television for viewer attention. FCC regulations for ITFS recognized this fact and permitted educators to reduce the technical production standards normally required for broadcasting. This permitted reduced ITFS production costs by as much as 75 percent, and therefore innovative services such as two-way, audio/visual teaching became both feasible and effective.[172]

At the time, ITFS was the only major educational telecommunications methodology generating its own operating

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[170]Tressel, 12.

[171]Ibid., 17.

[172]Curtis, 54.

support dollars. It survived this lack of federal support because operators of ITFS systems learned to manage their operations effectively. Because ITFS transmission was line-of-sight and used very low-powered, relatively simple equipment which did not require technical personnel, and because ITFS systems were lower in cost, local schools and service organizations could afford to invest time and money into ITFS. Unencumbered by outside financial attachments, they were possibly better able to determine and respond to local needs.[173]

Radio, television, and cable television were joined by other technologies for transmitting information, Microwave transmission became a technique used to reach the potential student without the regulatory constraints of radio and television. The development of satellite transmission in the 1970's provided the opportunity for students nationwide to receive educational programs outside the traditional classroom.[174]

Despite early successes, by the 1970's, CATV's subscriber growth rate was not as dramatic as expected. In most geographic areas, CATV systems reached less than 30 percent of the population and locations needing telecommunications-delivered educational and medical programming. Few communities had two-way CATV systems capabilities. Until two-way, wired city and county CATV installations became more widely established, the national educational significance of CATV in structured curriculum processes would be restricted.[175]

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[173]Ibid., 55-56.

[174]Stern, 408.

[175]Curtis, 48.

In brief, the CATV industry during the 1970's continued to penetrate well the rural, county and city areas away from the areas saturated by commercial television broadcasting service. But it did not become the dynamic social force and communications system giant once predicted by it proponents. Neither had it become the money-making "machine" once envisioned.[176]

Satellite communications methodologies could effectively distribute two-way educational information. Since 1972, few, if any, new answers to the how, what, when, where, and how about the educational use of satellite have been made. There are, however, two facts about educational satellite circuits. One, they require five to six times more frequency spectrum than do earth-bound ITFS systems capable of providing the same telecommunications capabilities. Two, exclusive of the substantial costs of launching and maintaining a communications satellite, ground equipment requires a capital investment that is at least twice that of comparable earth-bound systems.[177]

In January 1970, the Nixon administration recommended to the FCC that private companies be permitted to build and operate communications satellites on an open competitive basis. In March 1970, FCC solicited proposals to aid in ascertaining the most effective kinds of satellite systems.[178] In 1973, the FCC approved a number of applications for domestic satellite

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[176]Ibid., 111.

[177]Ibid., 48-49.

[178]Ibid., 127.

systems. Western Union was the first company to initiate a domestic satellite system.[179]

In December 1974, a preliminary study, initiated by the PBS and financed by the Ford Foundation, indicated that a satellite interconnection system for public broadcasting would be feasible and desirable. The PBS, the CPB, and the Ford Foundation, established the Satellite Working Group, which throughout 1975 made detailed analyses indicating that a satellite interconnection system would provide public broadcasting with several advantages. In 1976, the CPB decided to construct its satellite interconnection.[180]

By the late 1970's, the educational community and others interested in the public service use of satellites would be able to take advantage of the existing systems.[181]

Some Federal agencies used distance education in executing their mission, while others funded curriculum development specifically targeted to remote learning environments, or provided technical assistance for planning and development. NASA's involvement with educational telecommunications began with the launch of the first communication satellites that were used for education in 1974 and has continued with many activities, including the transmittal of images from vehicles in space, the teacher in space program, and an ongoing videoconference series for teachers.[182] The first

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[179]Ibid., 130.
[180]Blakely, 213.
[181]Curtis, 145.
[182]Congress, 18.

satellite-delivered NASA educational effort was images from the Voyager mission to Jupiter in 1979 and Saturn in 1981.[183]

The owners of a large number of earth terminals, such as PBS, had receive only systems and earth-bound interconnects were required between the terminal and the user. Despite these problems, the concept of shared use would continue to be an impetus to the use of existing or planned non-education training satellite facilities and channels.[184]

MORE STRENGTH FOR CPB AND NPR

In mid-1976, representatives of the boards of the CPB and NPR approached the Carnegie Corporation to suggest that it set up a new commission to study public broadcasting and make recommendations for its future. On June 14, 1977, the corporation announced the formation of the Carnegie Commission on the Future of Public Broadcasting.[185] On October 6, 1977, President Carter submitted to Congress proposals "to strengthen our public broadcasting system and to insulate it from political manipulation." The President noted the duplication of programming functions by CPB, on one hand, and PBS and NPR on the other, with "unproductive feuds" and the waste of money.[186] Congress passed the 1978 Public Telecommunications Financing Act authorizing appropriations for three years instead of five in order to take into account the findings and recommendations of the commission.[187]

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[183]Ibid., 144.
[184]Curtis, 146-147.
[185]Blakely, 211.
[186]Ibid., 212.
[187]Ibid., 211.

Title III of the Public Telecommunications Act of 1978 broadened the responsibility of the CPB, in addition to those of public broadcasting, to include public telecommunications technologies, entities, and services. The trend was away from over-the-air broadcasting to what is sometimes called the "wired nation." In the 1978 financing act, the trend was seen in definitions of and provisions for facilities to be aided, entities to be supported, and services to be promoted.[188] Much more strongly than previous public broadcasting acts, the 1978 act encouraged and required planning.[189]

MICROCOMPUTERS

In the 1940's, three American inventors, John Bardeen, Walter Brattain, and William Schockley, revolutionized radio circuits with the invention of the transistor. In 1944, the first major digital computer was put into use. By the early 1960's, individual electronic components were replaced with integrated circuits.[190]

It was not until the beginning of the 1980's that a vitalized interest in instructional computing began to appear. In August 1981, IBM introduced its first Personal Computer (PC). The development of the low-cost and small-sized microcomputer excited educators. While many viewed the small computer as a toy that would lacking the sophistication needed for serious instructional computing, others saw the emerging microcomputer for what it could be, a powerful tool capable of altering the

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[188]Ibid., 218-219.
[189]Ibid., 220.
[190]Kinzer, 23.

course of education.[191] Many planned and unplanned technical changes happened at once. The biggest technical changes during the 1980's, the tremendous use of microcomputers and of communication on the existing networks, were unanticipated.[192]

A number of companies offer automated information services which can be accessed from remote terminals operated by subscribing libraries. A microcomputer can be equipped with a modem and accompanying software package which will enable it to communicate with a remote computer. Microcomputers can also be used to search remote data bases and the results of a given search can be "downloaded" to a disk for subsequent editing and manipulating. Search services also offer on-line access to encyclopedia and other reference books. Bibliographic utilities can likewise support microcomputers equipped with modems in place of the conventional terminals previously used by subscribing libraries.[193]

MORE FEDERAL ACTIVITIES IN DISTANCE EDUCATION

Government regulation of telecommunications infrastructure and services continues to affect the availability, cost, and types of services schools can use. The FCC determines the allocation of the public spectrum, including the number of ITFS channels. In 1983, the FCC removed underused spectrum from ITFS and also allowed licensees to lease ITFS channels from other users, resulting in fewer channels being available for

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[191]Ibid., 26.

[192]Sara Kiesler and Lee Sproull, eds., Computing and Change on Campus (Cambridge, Mass.: Cambridge University Press, 1987), 226.

[193]Kinzer, 344.

education. The FCC also controls the licensing of satellites.[194]

The Department of Education Training Technology Transfer Office was authorized in the Omnibus Trade Act of 1988.[195] The Omnibus Trade Act also created the Star Schools Program[196], a comprehensive Federal effort to develop multistate, multi-institutional K-12 distance education.[197] The Star Schools Program has accelerated the growth of distance education through direct purchasing power. The Star Schools legislation, and the national attention it gave to distance education, served as a catalyst for planning and development beyond the projects that were funded in the first round.[198] The Star Schools networks did not commence their full-scale efforts until September 1989.[199]

THE LAST YEARS

At the adult level, distance education has been embedded for many years in the corporate, military, and university continuing education sectors. The technological spur for the rapid expansion of distance education efforts in the past 5 to 10 years was the advent of video teleconferencing technologies, which allowed two-way audio and video interaction. In 1987, there were over 40 generic delivery systems that provided video

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[194]Congress, 150.

[195]Ibid., 20.

[196]See Appendix G for some basic facts and figures for the Star Schools Projects.

[197]Congress, 135-136.

[198]Ibid., 15.

[199]Ibid., 140.

conferencing to business and education, in addition to the many private networks in place.[200]

State-mandated curriculum reform, which increased requirements for high school graduation or college admission, is driving many efforts. At the same, some districts have created local and regional distance education applications to share their existing pool of teachers and students more efficiently.[201]

More and more students receive enrichment activities delivered by distance education technologies. In 1989, the Satellite Education Resources Consortium (SERC) offered science, technology, and society seminars to over 18,000 students. The Telelearning Project takes its students on "electronic field trips," telephone conference calls to outside authorities, and to other classrooms.[202]

In the Office of Technology Assessment (OTA) analysis of State policies, 21 states were studied for their policies regarding distance education. Only 7 of the 21 States sampled had a policy document specific to distance education.[203] Of all the States, fewer than 10 were promoting distance education in 1987. Today virtually all States have an interest or involvement in distance education.[204] [205]

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[200]Ibid., 25.

[201]Ibid., 5.

[202]Ibid., 31.

[203]Ibid., 117.

[204]See Appendix H for a review of state-by-state distance education activities.

[205]Congress, 4.

A LAST WORD ON KEY DELIVERY SYSTEMS

Local and regional telephone companies serve distance education through the transmission of voice, graphics, and data over the public network, and the management of dedicated (private) networks for video which are carried through public facilities. Local and regional telephone companies are prohibited from delivering video over the public network at this time because of restrictions resulting from the Cable Act of 1984.[206]

Although CATV is today a sizable operation, the 30-year-old fledgling has yet to become the mighty and comprehensive giant once predicted. In 1971, the Sloan Commission on Cable Communications predicted that CATV would have penetrated 40-60 percent of the national market by 1980. By the end of 1979, its penetration is approximately 17 percent.[207]

Over-the-horizon technologies may enable CATV to provide economically the multi-channel and two-way audio-video and digital circuit capabilities required for the delivery of many educational, social and medical services.[208]

The number of schools with satellite dishes is growing rapidly. Data from the 1988-1989 school year indicates that approximately 7 percent of school districts had satellite dishes.[209] The 1987 Satellite Directory identified at least 39

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[206]Ibid., 42.
[207]Curtis, 109.
[208]Ibid., 120.
[209]Congress, 67.

video-capable "uplinks," or transmitters aimed at satellites, owned and operated by postsecondary institutions, up from 23 identifiable university uplinks in the 1986 directory. These are deceptively low figures, since many uplinks owned by PBS are located on university campuses and could be used for delivering instruction.[210]

The period between 1977 and 1984 saw relatively little use of satellites for the delivery of postsecondary instruction. Individual universities appeared to be minimally involved.[211]

A new era in the use of satellites for postsecondary instruction began in 1984-85, when additional consortia and individual began exploring the technology in earnest. At least 87 satellite courses were scheduled for 1988-89. All of these were in addition to the extensive list of courses offered by satellite by the National Technological University (NTU). NTU was founded in 1984 by the Association for Media-Based Continuing Education for Engineers (AMCEE) for the purpose of providing advanced degree opportunities to engineers at their work sites throughout the country. NTU has been fully accredited by the North Central Association. Some experts believe that NTU will be the largest producer of masters degrees in the United States by the mid-1990's.[212]

Since the divestiture of the Bell Operating System in 1984, the Public Switched Telephone Network (PSTN) has been changing

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[210]Michael J. Albright, "The Past, Present, and Future of University-Level Instruction by Satellite," TechTrends (November/December 1988): 23.

[211]Ibid., 25.

[212]Ibid., 25-26.

rapidly. Several trends are driving this change. The network is increasingly digital. The use of digital fiber optic lines is pushing implementation of other digital technologies such as digital switches. These switches (which are actually specialized computers) are essential for the development of intelligent networks. Fiber optics and digital technology are the prerequisites for advanced broadband networks capable of carrying high-speed data and switched video applications.[213]

THE FUTURE OF DISTANCE EDUCATION TECHNOLOGY

In a widely-circulated report on instructional technology, the Carnegie Commission on Higher Education predicted that by the year 2000[214] at least 80 percent of off-campus instruction conducted by colleges and universities would be delivered by emerging informational technologies.[215]

The next 5 years present a critical window of opportunity, while investment decisions are being made, for evaluation of and experimentation on distance education. Research on technology-mediated learning and interactivity, instructional design and innovative approaches, and applications of cognitive theory represent good investments for the Federal Government in order to meet the long term needs of the field.[216]

Technology can be a tool to reach teachers with training, information, and resources that enhance their skills and expand

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[213]Congress, 74.

[214]See Appendix I for the the Gartner Group Strategic Planning Assumption to the year 2000.

[215]Albright, 23.

[216]Congress, 11.

their knowledge.[217] The critical role of teachers in effective learning means that all must have training, preparation, and institutional support to successfully teach with technology. Distance learning has dual impacts on teachers: as a tool for teaching and as a means to upgrade their own skills and professional development. Few teachers have had either teacher education or field experiences that enable them to be effective distant teachers or successfully use technology in their own classroom.[218] Teachers and administrators alike must make an effort to become computer literate and learn to use this new tool in creative and meaningful ways.[219] Up until now the emphasis has been on first learning about computers and then learning from computers, but in the future the emphasis will be on learning with computers.[220]

There is almost universal agreement that two-way communication is a necessary element of long-distance education. Many educators are turning to the telephone, one of the oldest and most effective mediums as a method of providing two-way communications. A telephone network is interactive, allowing students and instructors to exchange information, ask questions, and receive immediate feedback. The process of interaction between faculty and students is perhaps the most important of the educational processes.[221] Converting a one-way system to two-way operation may require extensive redesign and upgrading, depending on the age and condition of the system.[222]

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[217]Ibid., 6.
[218]Ibid., 11-12.
[219]Kinzer, 28.
[220]Ibid., 128.
[221]Curtis, 64.
[222]Congress, 69.

Possible changes in the Cable Act of 1984 could allow communities more direct control over cable operations, and could allow telephone companies to compete with the cable operators in the provision of video services. Cable companies might eventually merge with telephone companies if cross-ownership rules are relaxed.[223]

Public Service Telephone Networks (PSTN) may become less a telephone network and more a general-purpose broadband network capable of carrying all types of traffic, including audio, data, and video. However, because of the many political, economic, and regulatory issues involved, the time frame for the development of this network is uncertain.[224]

Over 98 percent of the country's households receive television programming, with almost half of that number subscribing to cable television. Clearly, if we only use these technologies for entertainment and data transmission, we will miss a primary vehicle for learning.[225]

Although newer instructional technologies have captured more attention recently, it does not appear that the new technologies will supplant traditional distance education programs such as telecourses. It is more likely that all technologies, old and new, will be added into ever more diverse mixtures of distance instructional delivery systems. It should

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[223]Ibid., 71.
[224]Ibid., 77.
[225]Stern, 416.

be noted that telecourses continue to enroll the bulk of degree-seeking distance education students.[226]

Satellite technology is the fastest growing medium for distance education in the United States.[227] A shortage of satellite capacity (both C-band and Ku-band) may develop. Demand for satellite services has increased rapidly, especially in the business sector. The generation of satellites currently in orbit is due to be retired in the early 1990's. Ka-band satellite technology is the most advanced technology being developed, but no Ka satellites will be operational until the early to mid-1990's. Ka-band satellites will use frequencies which will allow them to transmit more information. Ka-band receive dishes are expected to be smaller (one meter in diameter), cheaper, and easier to install than today's Ku dishes. NASA's Advanced communication Technology Satellite, scheduled for deployment in the early 1990's, will be Ka-band. Ka-band satellites, using on-board switching and narrower transmission beams, may eventually direct point-to-point (school-to-school) communication.[228]

The computer has become the common thread running through these diverse activities we have discussed in this paper. Technological convergence can be thought of as the coming together of these various disparate and disjunct technologies and functions, resulting in their embodiment in a single point of access workstation. There are at least four factors which

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[226]Carol Cross, "New Technology Revitalizing Colleges' Interest in Distance Learning Programs," Community College Week, 15 October 1990, 1.

[227]Chris Clark, "Distance Education in the United States Schools," The Computing Teacher, March 1989, 10.

[228]Congress, 67.

encourage this convergence: 1) digitalization of information; 2) distributed computing; 3) advances in mass storage; and 4) growth of telecommunications networks.[229]

Due to the advances in technology and a corresponding reduction in cost, universities and other organizations are expanding their use of the two-way visual and audio communication systems known as teleconferencing. Three key elements are behind its rapid growth. The first is the falling price of the central element in a video teleconferencing system, the codec, which compresses the television signal enough to be transmitted through telephone lines. Second is the creation of a technical standard that allows equipment from different manufacturers to communicate. The third element is the increased availability of, as well as lower rates for, transmission lines offered by AT&T, US Sprint and several other long-distance carriers. If you compare 1989 and 1988, you will see a tripling of codec shipments. In addition to the current generation of video conferencing systems, which usually involves a large console housing monitors, cameras, audio equipment and codec, several companies are working on hybrid desktop systems that merge two-way audiovisual communications with personal computers. One system recently introduced allows up to eight people to talk with each other face-to-face through their personal computers. This system lets participants create a split-screen image on each terminal, allowing as many as four people to see each other at one time.[230]

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[229]Charles Forrest, "Technological Convergence: A Brief Review of Some Developments in the Integrated Storage and Retrieval of Text, Data, Sound and Image," TechTrends (november/December 1988): 8.

[230]Richard Lipkin, "Callers Look Each Other in the Eye,"

An entire industry is being built around the concept of the marriage of the personal computer and the television. The different aspects of this marriage have been rolled up in a single word, multimedia. Multimedia defines the PC platform of the 1990's. While many educators and students have adapted themselves to communicate with computer through typing at a keyboard and receiving a textual response, or maybe even a two-dimensional graphic image, most people in education will not find computers truly useful until they can communicate with the computer the way people communicate with each other - with motion, sound, and real-time interaction.[231]

As we deliberately design a radical system to challenge the traditions of the school building and the four walls of the classroom, we may determine that learning takes place wherever people and material can come together. Certainly the home will be considered more and more of a learning center.[232]

ARTIFICIAL INTELLIGENCE

During the last ten years of the twentieth century, the enlightened countries are looking toward increasing the growth of human thinking with the machine speed and power of the computer. One of the more promising ways of increasing the thinking power of the masses is the application of artificial

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Insight, September 17, 1990, 42-43.

[231]Loretta Wilkinson, ed., "Interactive Multimedia: Making the Invisible - Visible," The University of Akron Computer Based Education Newsletter, Fall 1990, 10.

[232]Wood, 231.

intelligence. Artificial intelligence is concerned with making computers behave in ways that we would consider intelligent in a human being. The idea of machine intelligence has been a source of fascination since ancient times. Intelligent tutoring systems use artificial intelligence techniques to help a person learn. These programs enable students to query the computer as they proceed through a Socratic interaction with a tutoring program or learning tool.[233]

For the past several years, Lucasfilms, Apple Computer, and the National Geographic Society have been developing an interactive multimedia system for teaching. The system includes a videodisc containing several hours of stored information, including film clips, sound and still images, and a computer program designed to guide students through a self-controlled learning experience. Students can use the system to study any period of American history that interests them - from before Columbus up to the present. This is accomplished by drawing on thousands of images, printed text, and music. In addition, students can develop programs that explore the music of the Civil War or the migrations of native peoples. Many will find the cost of the software and videodiscs ($650) is relatively low in relation to the potential of the system. "Our goal was to focus on the creativity of the students," states Lucasfilm's Craig Southard. Users of such a virtual reality system can experience touch, sight, and hearing while in the computer generated world. In some systems, it is even possible to interact with other users.[234]

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[233]John J. Hirschbul and Rose Marie Konet, eds., Computers in Education (Sluice Dock, Guilford, Conn.: The Dushkin Publishing Group, Inc., 1990), 216.

[234]Gayle Hanson, "A World That Is Graphically Real,"

VIRTUAL LEARNING ENVIRONMENTS

Distance learning is changing educational boundaries, traditionally defined by location and by institution. In the pooling of students and teachers, distance learning efforts reconfigure the "classroom." No longer bound by the physical space, classrooms extend to other students in the same district, to other districts, to other States, or even across national borders. When this happens, institutional arrangements necessarily change.[235]

With the imminent introduction of interactive multimedia systems into the classroom, computer scientists are poised to produce a learning experiment that could radically alter the way children learn. The latest computer graphics technology enables human beings to "enter" and "experience" the world created by computers. Virtual reality promises to revolutionize disciplines as diverse as the fine arts, medicine, computer imaging, architectural design, education, and robotics. Computer graphics specialists have used fractal geometry to create entire landscapes, which appear realistic, replete with mountains, forests, and clouds. Comparatively inexpensive programs exist for the creation of fractal images that can be plugged into most personal computers[236]

The possibility of putting students and the classroom in touch with the external intellectual environment is one of the most exiting promises of communication and computer technology.

Insight, October 8, 1990, 43-44.

[235]Congress, 27.

[236]Hanson, 42-43.

A field trip to anywhere can be as easy as pressing a key on a student's personal processor. If museums and libraries had digitally encoded copies of their possessions and simple means of network access, there would be no rich or poor schools. With the logistic problems of the field trip removed, there could be more of them and they could be open ended for individual students.[237]

FINAL COMMENTS

It is easy to get caught up in the many possibilities for distance education delivery systems, but this enthusiasm should be tempered by the words of futurist Christopher Dede who states, "Just because a device is technologically and economically feasible does not mean that it will be used."[238] But in the last 100 plus years, that has not stopped us.

No one can pretend to know what the future holds for educational telecommunications. The potential is unlimited; the stakes are high. In preparation for consideration of the present and the future, we have examined the past - for the purpose of underscoring the main events - in five dramatic acts: (1) The early history of educational radio (1917-1948); (2) the

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[237]William H. Bossert, "The Use of Technology to Improve Two Key Classroom Relationships," in Technology in Education: Looking Toward 2000 (Harvard University, Cambridge, Mass.: Lawrence Erlbaum Associates, Inc., 1988) in Computers in Education (Sluice Dock, Guilford, Conn.: The Dushkin Publishing Group, Inc., 1990), 155.

[238]Christopher Dede, "The Evolution of Distance Learning: Technology-Mediated Interactive Learning," Journal of Research in Computing in Education 22 no. 3 (Spring 1990): 261.

FCC freeze (1948-1952); (3) the decade of growth and evolution (1953-1962); (4) regrouping and professional introspection (1962-1967); and (5) the new identities (from 1967). It has been an exciting and sometimes turbulent drama. It has been a fast-paced century.[239] And the past has been but a prologue.

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[239]Wood, 70.

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